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TEXAS AGRICULTURAL EXPERIMENT STATION

B. YOUNGBLOOD, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

BULLETIN NO. 363 JULY, 1927

SORGO SILAGE, SORGO FODDER AND COTTONSEED HULLS AS ROUGHAGES IN RATIONS FOR FATTENING CALVES

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SYNOPSIS

Livestock production or feeding is an enterprise that has not been generally practiced by Texas farmers to the present time, although past experience in the corn-belt section of the United States and in some of the older European countries has shown that the inclusion of livestock in the farming program is the most permanent and profitable system of agriculture. As a result of a properly balanced system of farming, the soil is enriched and maintained at a higher degree of fertility than is possible or practical where livestock are not included in the general scheme of farm operations.

The agricultural development has been so recent in West Texas that as yet there is available only a limited amount of reliable experimental information with reference to problems of fattening livestock. This Bulletin covers a series of three baby-beef feeding experiments conducted during the feeding seasons 1923-25 in cooperation with the United States Department of Agriculture at the Big Spring Field Station located near Big Spring, Texas.

A comparison of sorgo silage, sorgo fodder, and cottonseed hulls when fed in conjunction with ground milo heads and cottonseed meal to fattening calves was made. The average initial weights of the three groups of calves were as follows: 1923 test—429 pounds; 1924 test—506 pounds; 1925 test—309 pounds; thus providing an opportunity to compare the gains made by the calves of different ages.

The calves receiving sorgo silage and sorgo fodder made larger gains and put on a higher finish than the calves receiving cottonseed hulls. On account of their lower finish, the calves receiving cottonseed hulls sold on the market for lower prices than the others. Which ration would prove most profitable in the future would depend largely on the relative prices of feeds. At the prices paid in these tests the silage ration proved the most profitable in two instances and the fodder ration was most profitable in one test. Hulls were the least profitable in all three tests. The lower gain in weight of the lot receiving cottonseed hulls is attributed chiefly to the fact that the feeding value of this ration was considerably less than that supplied the sorgo silage and fodder lots.

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SORGO SILAGE, SORGO FODDER, AND COTTONSEED HULLS AS ROUGHAGES IN RATIONS FOR FATTENING CALVES*

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Thousands of acres of tillable West Texas lands formerly utilized for grazing purposes only are being placed under cultivation during each succeeding year. Vast areas are being planted to cotton, grain sorghum, sorgo,‡ and other crops. A considerable readjustment in agriculture is under way in West Texas. New or additional information is needed by those who are engaged in feeding or finishing live stock or who may be considering using live stock to market these crops.

Live stock production or feeding is an enterprise that has not been generally practiced by Texas farmers to the present time, although past experience in the corn-belt section of the United States and in some of the older European countries has shown that the inclusion of live stock in the farming program is the most permanent and profitable system of agriculture. As a result of a properly balanced system of farming the soil is enriched and maintained at a higher degree of fertility than is possible or practical where live stock are not included in the general scheme of farm operations. The agricultural development has been so recent in West Texas that as yet there is available only a limited amount of reliable experimental information with reference to problems of feeding live stock.

Some Previous Work

In a feeding test conducted by Burns and Metcalf of the Texas Station at Clarendon in 1911-12 (Texas Station Bulletin 153) a comparison was made of cottonseed hulls and silage composed chiefly of milo, when fed to three- and four-year-old steers. The results of that experiment indicated that a ration of cottonseed meal and silage may be used far more profitably than a ration of cottonseed meal and cottonseed hulls for fattening cattle. The silage-fed cattle finished better and sold at a slightly higher price.

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†Mr. V. V. Parr of the Bureau of Animal Industry assisted materially in the planning and supervision of these experiments.

‡Sorgo is the name given the sweet sorghums by the U. S. Department of Agriculture that they may be distinguished from the grain sorghums. The "Sumac" variety was used in this experiment.

In a feeding test conducted by Burns of the Texas Station in 1912-13 (Texas Station Bulletin 159) in comparing unchopped sorgo hay with cottonseed hulls when fed with silage to two-year-old steers, he found that those receiving sorgo hay made a slightly larger gain and finished better than those receiving cottonseed hulls. In another test by Burns (Texas Station Bulletin 198) in a comparison of cottonseed hulls and Sudan grass hay when supplemented with silage in the ration of fattening calves during the 1915-16 feeding season, the Sudan grass hay was found to be superior to cottonseed hulls. In the feeding season 1919-20, Burns (Texas Station Bulletin 263) conducted a test with Hereford yearlings with a view of determining whether any advantage would be gained in substituting sorgo silage for a part of the cottonseed hulls in a ration composed of cottonseed meal, ground corn or milo, black strap molasses, and cottonseed hulls. In this test no advantage was gained by substituting sorgo silage for a portion of the cottonseed hulls.

At the North Carolina Station, Curtis (North Carolina Bulletin 222) compared corn silage and cottonseed hulls for fattening steers averaging from two and one-half to three years of age. The results of Curtis' investigation showed that although cattle fed on cottonseed hulls make good daily gains during the first 60 days on feed, the rate of gain declines rapidly during the latter part of the feeding period at the expense of the proper finishing of the cattle. In the lots that received corn silage either as a part or the entire roughage portion of the ration, the average daily gains were more uniform throughout than the gains made by the lot receiving cottonseed hulls.

In a cooperative steer feeding experiment between the Bureau of Animal Industry, United States Department of Agriculture and the North Carolina Station, 1914-15, Ward, Curtis and Peden (U. S. D. A. Bulletin 628) when comparing corn silage and cottonseed hulls fed to two- and three-year-old steers found that the steers which received corn silage as the entire roughage portion of the ration made much more efficient and economical gains than when cottonseed hulls constituted the entire roughage portion.

In a comparison of corn silage and cottonseed hulls at the Tennessee Station by Willson and Robert (Tennessee Station Bulletin 104) when fed to 231 two-year-old steers in 23 experiments the results showed that "much better gains may be made through the use of silage with cottonseed meal than through the exclusive use of cottonseed hulls for the roughage portion of the ration. When silage is fed, however, greater gains may be made by the addition of a small amount of some dry feed, such as hulls." Steers fed silage and cottonseed meal made 7.3 per cent better gains than steers fed cottonseed hulls and meal. Steers fed a combination of cottonseed meal, corn silage, and cottonseed hulls made 18.9 per cent better gains than steers fed a ration of cottonseed meal and hulls. It was further concluded from the Tennessee

experiments that a wider margin is necessary when cottonseed hulls are fed than when corn silage is fed.

Object of Experiment

This experiment was planned for the purpose of determining the relative feeding values of sorgo silage, sorgo fodder, and cottonseed hulls, respectively, as sources of roughage in the rations of fattening calves. The region in which this experiment was conducted is well adapted to the production of cotton and the more common varieties of the sorgos; consequently stockmen interested in finishing cattle are anxious to have more information with reference to the comparative feeding values of sorgo feeds and cottonseed hulls. The method of preservation and preparation of the sorgo roughages is also of importance, hence the reason for comparing sorgo silage and sorgo fodder.

General Plan of the Work

Comparisons were made in three consecutive years, 1923 to 1925, inclusive, of sorgo silage, sorgo fodder, and cottonseed hulls, when fed in conjunction with milo heads and cottonseed meal, to fattening calves. The experiment was conducted cooperatively by the Bureaus of Animal Industry and Plant Industry of the U. S. Department of Agriculture and the Agricultural Experiment Station of the Agricultural and Mechanical College of Texas, at the Big Spring Field Station, located near Big Spring, Texas.

In each of the three tests representative groups of well-bred Hereford calves of weaning age were fed. Individual fire-brand or ear-tag numbers were given to each calf as a means of identification. The calves were weighed individually on three consecutive days at the beginning of each experiment, afterwards being divided as equally as possible with reference to size and type into three groups. The averages of the three initial and final weighings, respectively, constituted the initial and final weights. The individual weights were taken at regular 28-day periods throughout the respective experiments, all weighings starting promptly at 1 p. m. The respective periods of feeding varied from 168 to 203 days in the three tests. The following rations were fed in each of the three tests:

Lot 1. Ground milo heads, cottonseed meal, sorgo silage, and Sudan grass hay.

Lot 2. Ground milo heads, cottonseed meal, and cottonseed hulls.

Lot 3. Ground milo heads, cottonseed meal, and sorgo fodder.

Equipment of Feed Lots. An open shed 20 feet deep by 78 feet in length (south exposure) provided shelter to protect the calves during inclement weather. Each lot had an area of 60 feet by 26 feet. The feed bunks were made of 2-inch plank and were 18 feet long, 3 feet wide, and 12 inches deep, and the base stood at a height of 1 foot above the ground. A fresh supply of water was available at all times.

A liberal supply of granulated stock salt was available in boxes under the shed throughout the feeding period. The feed lots were situated on a sandy loam soil and mud was not a serious factor even during wet weather.

Method of Feeding and Handling the Calves. The calves were fed twice each day, the morning feed being given about 8 a. m. and the evening feed about 6 p. m. The concentrates, consisting of ground milo heads and cottonseed meal, were weighed and then thoroughly mixed before being spread over and carefully mixed with the respective roughages in the feed bunks.

The sorgo fodder which was supplied to Lot 3 was run through the silage cutter before being fed. Sudan grass hay was fed once daily to Lot 1, this roughage being placed in the feed bunk after the calves had consumed the bulk of the silage-concentrate mixture. In the first test, all lots received the same amount of cottonseed meal. However, during the second and third tests Lot 2, receiving cottonseed hulls, was fed a slightly increased amount of meal as compared with the other two lots for the purpose of determining whether this would tend to offset the lower feeding value of the cottonseed hulls fed to Lot 2.

Calves Used. The calves used in all three tests were high-grade Herefords. Those used in the first and third years were raised near Stanton, Texas, and those of the second year in the vicinity of Big Spring.

The calves used the first year (1923-24) were delivered to the Big Spring Field Station November 24 at an average cost of $27.50 per head. As these calves had not been weaned previously, they were given a preliminary feeding until December 5 on a ration of 2 pounds of ground milo heads, 4 pounds of sorgo silage, 2 pounds of sorgo fodder and 2 pounds of cottonseed hulls. The calves weighed an average of 429 pounds at the time of going on experiment, December 5.

The steers used the second year (1924-25) were late winter and early spring calves and were delivered to the station on November 9 at a cost of $32 per head. They averaged 506 pounds, or about 75 pounds heavier than those used the year preceding. These calves were dehorned and branded on November 12 and placed on experiment November 15.

The calves used the third year (1925-26) were late-spring and early-summer calves, and weighed 120 and 197 pounds less than those used in 1923-24 and 1924-25, respectively. They were delivered to the station on November 11 and placed on test November 13.

Forty-five head of calves were purchased each year and divided as evenly as possible into three lots. One steer in Lot 2 of the last year's test was removed from the experiment shortly after starting, due to impaction of the rumen.

Feeds Used. The feeds used in all of the tests were of good quality. The cottonseed meal used sold under a guarantee of 43 per cent pro-

tein. However, two analyses made each year by the Texas State Chemist showed only 40.6 per cent protein the first year, 40.2 per cent the second, and 41.7 per cent the third year. A large portion of the milo heads used the first two years were shipped in from the Panhandle region of Texas, whereas during the last year they were all produced locally. The milo heads were finely ground and there was practically no waste either of grain or ground-head roughage. The sorgo silage was made from the first cutting of the sumac variety of sweet sorghums, and was of good quality. The sorgo fodder was also of the first cutting and was of good quality. The cottonseed hulls were of a fair to good quality. The Sudan grass hay fed to Lot 1 was of good quality.

The analyses of the various feeds used as determined by the Texas State Chemist are given in Table 1.

Table 1.—Composition of feeds used during experiment (based on two analyses of each feed).

Kind of Feed	Year	Protein Per Cent	Water Per Cent	Ash Per Cent	Fat Per Cent	Crude Fiber Per Cent	Nitrogen Free Extract Per Cent
Cottonseed Meal	1923–24	40.61	7.83	5.20	6.14	12.95	27.27
	1924–25	40.20	6.71	4.85	8.62	11.15	28.47
	1925–26	41.74	6.43	5.17	8.18	11.33	27.15
Ground Milo heads	1923–24	9.67	12.67	2.62	2.29	5.52	67.23
	1924–25	9.47	10.68	3.74	2.46	6.37	67.28
	1925–26	9.28	10.25	3.53	2.33	7.77	66.84
Sorgo Fodder	1923–24	5.60	32.12	6.84	2.18	14.33	38.93
	1924–25	5.03	27.45	4.79	1.71	14.75	46.27
	1925–26	5.04	30.41	6.26	1.48	14.43	42.38
Sorgo Silage	1923–24	2.23	70.80	2.24	.69	6.21	17.83
	1924–25	2.03	72.89	1.65	.72	5.36	17.35
	1925–26	1.30	78.60	1.97	.53	5.77	11.83
Cottonseed Hulls	1923–24	4.27	9.26	2.62	1.00	48.39	34.46
	1924–25	4.54	8.41	2.50	1.37	43.60	39.58
	1925–26	4.25	9.19	2.91	1.02	45.98	36.65
Sudan Grass Hay	1924–25	7.50	9.31	6.77	2.08	26.42	47.92
	1925–26	8.23	7.44	7.14	1.80	30.55	44.84

Prices of Feeds. The prices of milo heads, cottonseed meal, and cotton seed hulls are listed at actual cost, while the values assigned the sorgo silage, sorgo fodder, and Sudan grass hay which were produced on the Station were based on a conservative estimate of the price values. In this experiment the feeds were valued as shown in Table 2.

Table 2.—Prices of feeds used in experiment.

Feeds	Years		
	1923–24	1924–25	1925–26
Ground milo heads, per ton	$ 27.40	$ 30.00	$ 25.00
Cottonseed meal, per ton	45.30	42.00	33.00
Sorgo silage, per ton	6.00	6.00	6.00
Sorgo fodder, per ton	10.00	12.00	10.00
Cottonseed hulls, per ton	12.50	10.50	10.00
Sudan grass hay, per ton	15.00	15.00	12.00

Weather Conditions During Test. Table 3 shows the maximum and minimum temperatures as well as the distribution of rainfall during the experiment.

Table 3.—Weather data for period of experiment.

Month	Maximum Temperature, Degrees F.			Minimum Temperature, Degrees F.			Precipitation, Inches		
	First Year	Second Year	Third Year	First Year	Second Year	Third Year	First Year	Second Year	Third Year
November	....	71	65	.....	39	34	.....	.05	.00
December	53	57	53	33	27	25	1.69	.13	.00
January	54	56	51	24	22	26	.03	.15	.98
February	57	70	68	30	34	33	.50	.00	.06
March	63	78	63	35	45	37	.62	.00	2.18
April	77	83	69	47	54	45	.91	4.43	2.24
May	82	81	87	55	56	61	2.85	1.02	1.96
June	.....	.....	90	.....	.....	63	.....	....	.01
Total	.....	.....	.....	.....	.....	.....	6.60	5.78	7.43

THE 1923-24 TEST

Rations and Gains by Periods for First Test (1923-24)

During the first 28-day period, as may be observed by referring to Table 4, the calves in each of the respective lots consumed an average of 4.47 pounds of ground milo heads and 1.08 pounds of cottonseed meal per head with all the roughage that they would clean up daily. The average daily increase in weight per head during the first period as shown in Table 4 was 1.51 pounds for Lot 1 receiving sorgo silage, 1.49 pounds for Lot 2 receiving cottonseed hulls, and 1.3 pounds for Lot 3 receiving sorgo fodder.

The rations were gradually increased throughout the entire fattening period until during the final period of seven days the calves were receiving an average of 13.3 pounds of ground milo heads, 2 pounds of cottonseed meal per head and all the roughage that they would consume daily.

The average daily rations as well as average daily and total gains by periods are shown in Table 4.

Quantity and Cost of Feed Required to Produce 100 Pounds of Gain

The manner in which the calves responded to sorgo silage, cottonseed hulls, and sorgo fodder is illustrated in Table 5. This table shows the amount of feed required to produce 100 pounds of gain in the respective lots by 28-day periods. The average feed requirement per one hundred

Table 4.—Average daily rations and gains by periods, 175 days, 1923-24. Fifteen steers in each lot.

Lot No.	Ration	First 28-day Period Pounds	Second 28-day Period Pounds	Third 28-day Period Pounds	Fourth 28-day Period Pounds	Fifth 28-day Period Pounds	Last Period of 35 Days Pounds	Average All Periods Pounds
1	Ground milo heads	4.47	7.62	8.47	9.62	10.57	12.65	9.05
	Cottonseed meal	1.08	1.50	1.53	1.75	1.79	2.00	1.63
	Sorgo silage	16.93	19.99	20.00	19.52	19.07	19.55	19.17
	Sudan grass hay	1.75	1.50	1.29	1.38	1.62	1.76	1.56
	Total gain per calf	42.3	61.2	70.27	53.87	58.67	48.13	*334.4
	Average daily gain	1.51	2.19	2.51	1.92	2.10	1.38	1.91
2	Ground milo heads	4.47	7.62	8.47	9.62	10.66	12.65	9.06
	Cottonseed meal	1.08	1.50	1.53	1.75	1.81	2.00	1.63
	Cottonseed hulls	9.32	9.18	9.22	10.43	11.98	10.71	10.16
	Total gain per calf	41.69	23.33	61.73	39.87	39.53	33.93	*240.00
	Average daily gain	1.49	.83	2.20	1.42	1.41	.97	1.37
3	Ground milo heads	4.47	7.62	8.47	9.62	10.64	12.65	9.06
	Cottonseed meal	1.08	1.50	1.53	1.75	1.81	2.00	1.63
	Sorgo fodder	12.09	10.18	9.15	8.91	8.62	7.31	9.30
	Total gain per calf	36.42	49.06	64.53	44.26	54.93	41.33	*290.50
	Average daily gain	1.30	1.75	2.30	1.58	1.96	1.18	1.66

*Total gain for entire period.

pounds of gain for the 175-day period is also shown at the end of the table.

The cheapest gain was made in Lot 1, which received sorgo silage, the average feed cost per 100 pounds of gain being $12.03, as compared with $16.37 and $12.50 for Lots 2 and 3 receiving cottonseed hulls and sorgo fodder, respectively. The cost of gain is not always a criterion as to what the final profits will be. Although the cost of gains is generally important in the determination of the financial outcome of the feeding operation, other factors such as degree of finish must also be given proper consideration. If the most costly gains are accompanied by a proportionately higher degree of finish, the more costly gains will in a large measure be offset by the proportionately higher selling value of the cattle on the market; on the other hand, if the more costly gains do not increase the final selling value, the feeder is very likely to sustain a severe loss on the animals fed on such rations.

In this test the cottonseed hulls were charged against the calves at $12.50 per ton, this being the actual purchase price for the 1923-24 experiment. This price was unusually high for cottonseed hulls and is no doubt considerably higher than the average Texas feeder usually pays. It was necessary to ship the cottonseed hulls to Big Spring; hence the transportation charges were included in the cost. Feeders or prospective feeders should bear in mind that prices of feed are likely to vary considerably over a period of years. Therefore, when prices paid for feeds during a particular period are low, costs per 100 pounds of gain are also correspondingly lower than when prices of feeds are high. The data in regard to the gains made by the calves and the relative market desirability of the lots fed on different rations are not affected by the fluctuations in the prices of the feeds with varying seasons.

Marketing Data

The calves were sold on the Fort Worth market June 2, 1924, at prices in line with the Chicago market for that day, Lot 1 bringing $9.91 per hundredweight, Lot 2, $7.87, and Lot 3, $8.94. Live stock commission salesmen and packer buyers pronounced Lots 1 and 3, which had received sorgo silage and sorgo fodder, respectively, as being good uniform cattle, but lacking slightly in finish. The calculated* fatness of the three lots (based upon the dressing per cents and the amounts of internal fat) was 20 per cent for Lot 1, 14 per cent for Lot 2, and 22 per cent for Lot 3.

The cost of feed per calf was $40.24, $39.30, and $36.30, respectively, for Lot 1 receiving silage, Lot 2 receiving cottonseed hulls, and Lot 3 receiving sorgo fodder. Lot 1 made 94.4 pounds more gain than did Lot 2 receiving cottonseed hulls at a total cost of only 94 cents in excess of the total feed cost for Lot 2, while Lot 1 gained 43.9 pounds

*See Journal of Agricultural Research, Vol. 32, page 754, for formula.

Table 5.—Quantity of feed required to produce 100 pounds of gain, feed costs, and average gain per head by periods of 28 days.

First test, 1923-24.*

Period	Lot No.	Feeds Utilized Per 100 Pounds Gain						Cost of Feed Per 100 Lbs. Gain, Dollars	Average Gain Per Head During Periods, Pounds
		Ground Milo Heads, Pounds	Cotton-seed Meal, Pounds	Sorgo Silage, Pounds	Cotton-seed Hulls, Pounds	Sorgo Fodder, Pounds	Sudan Grass Hay, Pounds		
1	1 silage	296	72	1120	.....	.....	116	$ 9.91	42.3
	2 hulls	300	73	.....	626	.....	.....	9.67	41.7
	3 fodder	344	84	.....	.....	932	.....	11.27	36.4
2	1 silage	349	69	914	.....	.....	69	9.59	61.2
	2 hulls	915	180	.....	1101	.....	.....	23.50	23.3
	3 fodder	435	86	.....	.....	581	.....	10.81	49.1
3	1 silage	337	61	797	.....	.....	51	8.78	70.3
	2 hulls	384	69	.....	418	.....	.....	9.44	61.7
	3 fodder	367	66	.....	.....	397	.....	8.53	64.5
4	1 silage	500	91	1015	.....	.....	72	12.49	53.9
	2 hulls	675	123	.....	733	.....	.....	16.61	39.9
	3 fodder	608	111	.....	.....	563	.....	13.66	44.3
5	1 silage	505	85	904	.....	.....	77	12.13	58.7
	2 hulls	755	128	.....	848	.....	.....	18.54	39.5
	3 fodder	542	92	.....	.....	439	.....	11.71	54.9
6*	1 silage	920	145	1422	.....	.....	128	21.12	48.1
	2 hulls	1304	206	.....	1105	.....	.....	29.45	33.9
	3 fodder	1071	169	.....	.....	620	.....	21.60	41.3
Average all periods	1 silage	474	85	1003	.....	.....	81	12.03	334.4
	2 hulls	661	119	.....	741	.....	.....	16.37	240.0
	3 fodder	546	98	.....	.....	560	.....	12.50	290.5

*Sixth period, 35 days.

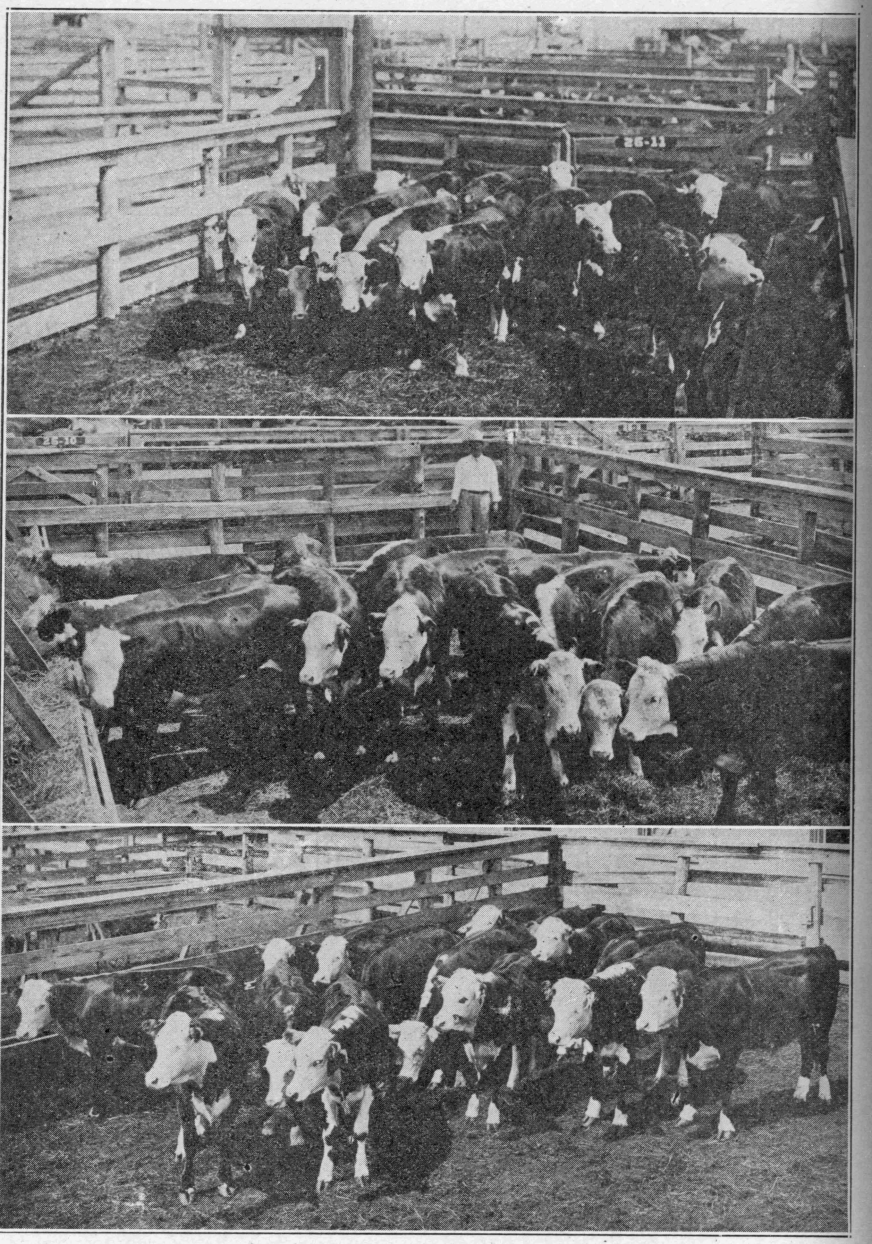

Figure 1.—Upper—Lot 1, fed sorgo silage, 1923-24.
Middle—Lot 2, fed cottonseed hulls, 1923-24.
Lower—Lot 3, fed sorgo fodder, 1923-24.

more per head during the 175 days' feeding period at a cost of $3.94 more than Lot 3. Lot 1 sold for $21.48 more per head than Lot 2, and $9.49 more than Lot 3. The increased return of Lot 1 is attributable to the seemingly higher finish carried by the calves in this lot before slaughter. Lot 1 sold for $2.04 more per 100 pounds live weight than Lot 2, and 97 cents per 100 pounds live weight above Lot 3.

Table 6.—Summary of results of first test, 1923-24. December 5, 1923, to May 28, 1924, inclusive, 175 days.

		Silage, Lot 1	Hulls, Lot 2	Fodder, Lot 3
Number of steers		15	15	15
Average initial weight at feed lot	pounds	428.9	433.02	425.17
Average final weight at feed lot	"	763.33	673.07	715.67
Average final weight at Fort Worth	"	723.33	638.66	696.00
Average gain per head, feed lot weights	"	334.4	240.00	290.50
Average gain per head, selling weights	"	294.43	205.66	270.83
Average daily gain per head, feed lot weights	"	1.91	1.37	1.66
Average daily gain per head, selling weights	"	1.68	1.18	1.55
Average daily ration:				
Ground milo heads	"	9.05	9.06	9.06
Cottonseed meal	"	1.62	1.63	1.63
Sorgo silage (Sumac)	"	19.17	.....	.....
Cottonseed hulls	"	.....	10.16	.....
Sorgo fodder (Sumac)	"	.....	.....	9.30
Sudan grass hay	"	1.56	.....	.....
Feed required per 100 pounds gain:				
Ground milo heads	"	473.55	660.75	545.77
Cottonseed meal	"	85.03	118.69	98.05
Sorgo silage (Sumac)	"	1003.23	.....	.....
Cottonseed hulls	"	.....	741.08	.....
Sorgo fodder (Sumac)	"	.....	.....	560.04
Sudan grass hay	"	81.56	.....	.....
Cost of feed per 100 pounds gain	dollars	12.03	16.37	12.50
Total feed consumed per head:				
Ground milo heads	pounds	1583.47	1585.80	1585.40
Cottonseed meal	"	284.33	284.87	284.82
Sorgo silage (Sumac)	"	3354.63	.....	.....
Cottonseed hulls	"	.....	1778.60	.....
Sorgo fodder (Sumac)	"	.....	.....	1626.87
Sudan grass hay	"	272.73	.....	.....
Financial Statement:				
Initial cost per steer	dollars	27.50	27.50	27.50
Cost of feed per steer	"	40.24	39.30	36.30
Shipping and marketing cost per head	"	3.77	3.77	3.77
Total cost of steer	"	71.51	70.57	67.57
Price received per steer	"	71.71	50.23	62.22
Necessary selling price to break even (per hundred pounds)	"	9.88	11.05	9.71
Selling price per hundred pounds, market weights	"	9.91	7.87	8.94
Profit or loss per steer		.20 Profit	20.34 Loss	5.35 Loss

Hogs Following Steers Made Small Gains

Two hogs averaging about 100 pounds were placed in each of the three lots at the beginning of the experiment for the purpose of utilizing wasted and undigested grain. However, they were removed at the end of the second 28-day period on account of their failure to make satisfactory gains. Even when fed 2 pounds of milo heads and one-fourth of a pound of tankage per head during the second 28 days, the average daily gain was only 0.83 pound per head.

Although cattle feeders have almost always found it profitable to

have hogs follow older cattle in the feed lot, the experience with hogs following young steers in this experiment tended to confirm the conclusions reached in previous work. In a test conducted by the Texas Experiment Station at Substation No. 7, 1921-22 (Texas Bul. 296), hogs following calves receiving ground milo and feterita heads and ground ear corn lost weight and were removed. The results indicate that young cattle especially utilize ground grain so efficiently that but very little undigested grain is available for hogs following the cattle.

THE 1924-25 TEST

Rations and Gains by Periods for Second Test (1924-25)

During the first trial, cottonseed meal was supplied to each lot on a similar basis. However, during this (the second) trial, Lot 2 receiving cottonseed hulls received an average of 0.27 pound more cottonseed meal per head daily throughout the entire 168 days than was supplied in Lots 1 and 3 receiving sorgo silage and sorgo fodder, respectively. This increase in cottonseed meal was allowed Lot 2 for the purpose of ascertaining whether or not it would tend to offset the lower feeding value of the hulls in this ration. However, as may be observed by referring to Table 7, the average daily gains made by Lot 2 receiving cottonseed hulls as the roughage portion of the ration were 0.4 pound less per head daily or 68 pounds less during the entire 168 days than the gains of Lot 1 which received sorgo fodder.

The maximum amount of concentrates utilized at any time by the calves was 16.3 pounds of ground milo heads per head daily fed to each of the three lots, while Lot 2 receiving cottonseed hulls, consumed as high as 3.3 pounds of cottonseed meal per head daily as compared with 3 pounds for Lots 1 and 3 receiving sorgo silage and sorgo fodder, respectively.

Quantity and Cost of Feed Required to Produce 100 Pounds of Gain

Table 8 illustrates the manner in which the cattle responded to the respective rations fed to the three lots throughout the 168-day feeding period in 1924-25. Lot 1 required 452 pounds of ground milo heads, 83 pounds of cottonseed meal, 766 pounds of sorgo silage, and 86 pounds of Sudan grass hay to produce 100 pounds of gain. The average cost per 100 pounds of gain for Lot 1 was $11.46. Lot 1 made more economical gains than the other lots.

Lot 2 required 555 pounds of ground milo heads, 116 pounds of cottonseed meal, and 542 pounds of cottonseed hulls to produce 100 pounds of gain at a cost of $13.60 or an increase of $2.14 above the cost of gains made by Lot 1.

Lot 3 required 461 pounds of ground milo heads, 84 pounds of cottonseed meal, and 480 pounds of sorgo fodder to produce 100 pounds of gain at a cost of $11.57 or a cost of only 11 cents above the cost of gains made by Lot 1.

It is illustrated quite clearly that there was a general tendency for the

Table 7.—Average daily rations and gains by periods, 168 days, 1924-25. Fifteen steers in each lot.

Lot No.	Ration	First 28-day Period, Pounds	Second 28-day Period, Pounds	Third 28-day Period, Pounds	Fourth 28-day Period, Pounds	Fifth 28-day Period, Pounds	Sixth 28-day Period, Pounds	Average All Periods, Pounds
1	Ground milo heads	4.32	8.00	10.10	10.86	12.89	14.98	10.19
	Cottonseed meal	0.86	1.60	1.68	2.03	2.16	2.86	1.87
	Sorgo silage	21.55	21.70	19.57	13.66	13.93	13.21	17.27
	Sudan grass hay	1.82	1.96	1.91	1.93	2.00	2.00	1.94
	Total gain per calf	60.87	68.60	64.87	57.40	76.2	50.91	*378.86
	Average daily gain	2.17	2.45	2.32	2.05	2.72	1.82	2.26
2	Ground milo heads	4.32	8.00	10.10	11.26	12.91	14.98	10.26
	Cottonseed meal	0.90	2.00	1.99	2.37	2.43	3.17	2.14
	Cottonseed hulls	10.84	10.75	11.22	10.92	9.12	7.38	10.04
	Total gain per calf	40.53	52.27	62.20	66.20	54.00	35.53	*310.75
	Average daily gain	1.45	1.87	2.22	2.36	1.93	1.27	1.85
3	Ground milo heads	4.32	8.00	10.10	11.26	12.91	14.98	10.26
	Cottonseed meal	0.86	1.60	1.68	2.10	2.16	2.86	1.88
	Sorgo fodder	11.62	12.85	11.44	11.34	9.15	7.68	10.68
	Total gain per calf	65.33	54.80	68.13	61.87	63.20	60.20	*373.55
	Average daily gain	2.33	1.96	2.43	2.21	2.26	2.15	2.22

*Total gain for entire period.

Table 8.—Quantity of feed required to produce 100 pounds of gain, feed cost, and average gain per head by periods of 28 days. Second test, 1924-25.

Period	Lot No.	Feeds Utilized Per 100 Pounds Gain						Cost of Feed Per 100 Lbs. Gain, Dollars	Average Gain Per Head During Periods, Pounds
		Ground Milo Heads, Pounds	Cotton-seed Meal, Pounds	Sorgo Silage, Pounds	Cotton-seed Hulls, Pounds	Sorgo Fodder, Pounds	Sudan Grass Hay, Pounds		
1	1 silage	199	39	991	.....	.....	84	7.41	60.9
	2 hulls	296	62	.....	743	.....	.....	9.63	40.5
	3 fodder	185	37	.....	.....	499	.....	6.54	65.3
2	1 silage	326	65	886	.....	.....	80	9.53	68.6
	2 hulls	428	107	.....	576	.....	.....	11.69	52.3
	3 fodder	409	82	.....	.....	657	.....	11.79	54.8
3	1 silage	436	73	845	.....	.....	83	11.22	64.9
	2 hulls	454	90	.....	505	.....	.....	11.35	62.2
	3 fodder	415	69	.....	.....	470	.....	10.49	68.1
4	1 silage	530	99	666	.....	.....	94	12.73	57.4
	2 hulls	476	100	.....	462	.....	.....	11.67	66.2
	3 fodder	510	95	.....	.....	513	.....	12.73	61.9
5	1 silage	474	79	512	.....	.....	74	10.87	76.2
	2 hulls	670	126	.....	472	.....	.....	15.16	54.0
	3 fodder	572	96	.....	.....	406	.....	13.02	63.2
6	1 silage	756	145	667	.....	.....	101	17.14	50.9
	2 hulls	968	205	.....	477	.....	.....	21.32	35.5
	3 fodder	629	120	.....	.....	323	.....	13.91	60.2
All periods	1 silage	452	83	766	.....	.....	86	11.46	378.9
	2 hulls	555	116	.....	542	.....	.....	13.60	310.8
	3 fodder	461	84	.....	.....	480	.....	11.57	373.6

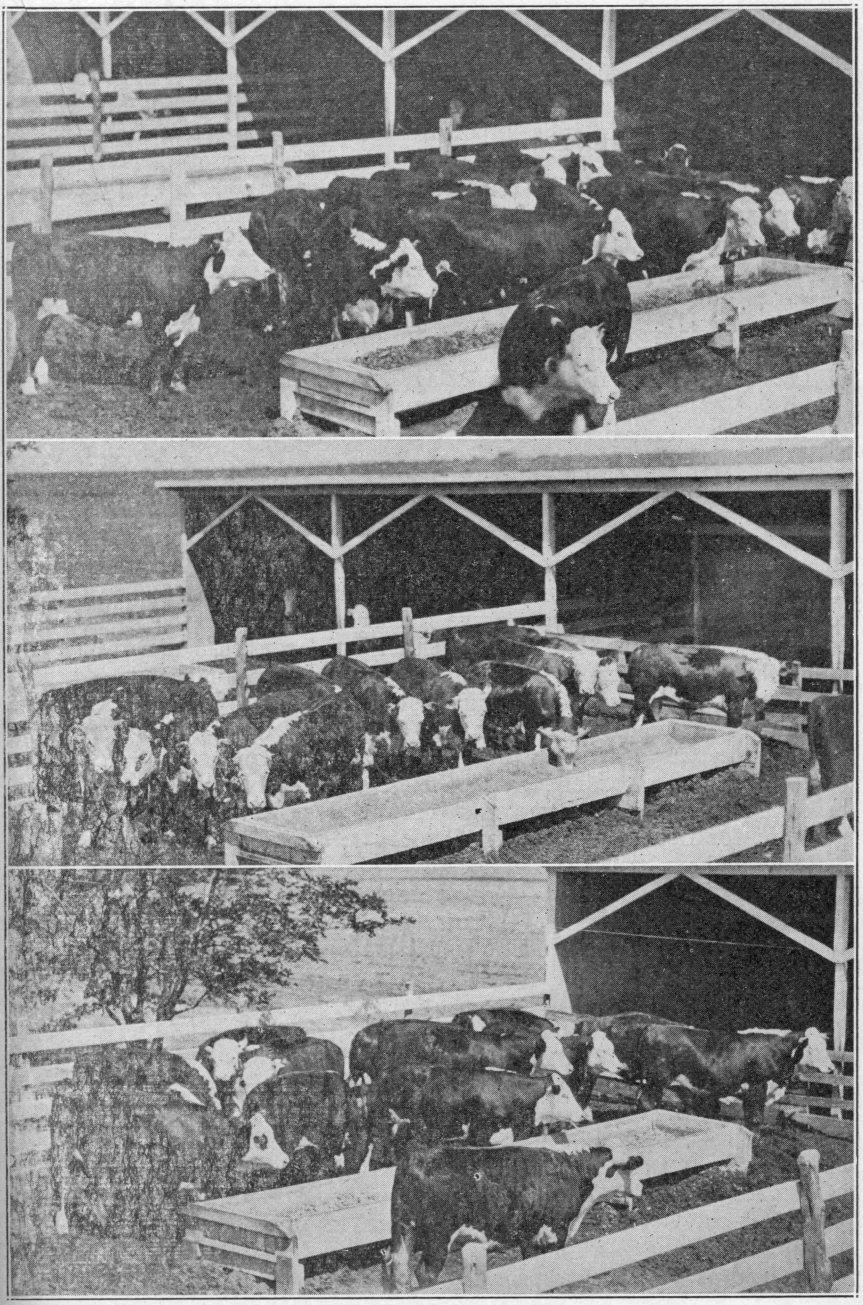

Figure 2.—Upper—Lot 1, fed sorgo silage, 1924-25.
Middle—Lot 2, fed cottonseed hulls, 1924-25.
Lower—Lot 3, fed sorgo fodder, 1924–25.

amount of concentrates required per 100 pounds of gain to increase as the fattening period advanced, the only exception in the 1924-25 test being for Lot 1 during the fifth 28-day period. This table serves to emphasize that when both sorgo roughages and cottonseed hulls are available as feeding stuffs, it is important that the prospective feeder take into consideration the productive values and the cost of the respective roughages per ton laid down at the feed lots. In each of the three feeding trials reported in this Bulletin, cottonseed hulls were necessarily charged against the cattle at prices somewhat higher than usual in Texas due to the fact that freight charges were included in the cost of the cottonseed hulls. The cottonseed hulls fed in the 1924-25 test were purchased at an actual cost of $10.50 per ton, a figure apparently considerably above their actual worth. The cheapest gain was made in Lot 1, which received sorgo silage, the average feed cost per 100 pounds of gain being $11.46 as compared with $13.60 and $11.57 for Lots 2 and 3 receiving cottonseed hulls and sorgo fodder, respectively.

Marketing Data

The calves were sold on the Fort Worth market May 18, 1925. Live stock commission salesmen and packer buyers pronounced the calves in Lots 1 and 3, which received sorgo silage and sorgo fodder as the roughage portion of the respective rations, as being the best and most uniformly finished cattle, and stated that Lot 1 carried a slightly higher finish than the fodder-fed lot. The calves in Lot 2, which had received cottonseed hulls, were not so highly finished as were Lots 1 and 3, although there seemed to be much less difference in finish this year than in the preceding year or in the following year. The estimated amount of fat in the live animals at the close of the experiment (estimates based on dressing per cents and on weights of internal fat) was 25 per cent for Lot 1; 26 per cent for Lot 2; and 25 per cent for Lot 3.

Table 9 shows that the Lot 1 calves gained 68 pounds more than did those in Lot 2, but only 5.3 pounds more than Lot 3. The additional 68 pounds gain of Lot 1 over Lot 2 was effected only at an additional feed cost of $1.13 over that of Lot 2. However, reference to Table 9 shows a profit of $11.43 per head for Lot 1 as compared with a 9-cent loss per head on Lot 2. Lot 3 showed a profit of $6.77 per head. In this test the larger profit returned by the calves in Lot 1 is attributable to the larger gain and their higher selling value on the market. This serves to emphasize the importance of properly finishing commercially fed cattle before offering them on the market as killers.

Lot 1 sold at $11.00 per 100 pounds straight through; fourteen calves in Lot 3 sold at $10.75, and one at $8.00; while eleven of Lot 2 sold at $10.50, and four at $9.50. The calf in Lot 3 which sold at $8.00 per 100 pounds was a large rough animal that presented a staggy appearance and the fact that this individual sold at a lower figure than the others of the lot was probably not due at all to the ration fed.

Table 9.—Summary of second test. November 25, 1924, to May 12, 1925, inclusive, 168 days.

		Silage, Lot 1	Hulls, Lot 2	Fodder, Lot 3
Number of steers		15	15	15
Average initial weight at feed lot	pounds	506.58	504.45	506.65
Average final weight at feed lot	"	885.44	815.20	880.20
Average final weight at Fort Worth	"	823.33	760.00	812.00
Average gain per head, feed lot weights	"	378.86	310.75	373.55
Average gain per head, selling weights	"	316.75	255.55	305.35
Average daily gain per head, feed lot weights	"	2.26	1.85	2.22
Average daily gain per head, selling weights	"	1.88	1.52	1.82
Average daily ration:				
Ground milo heads	"	10.19	10.26	10.26
Cottonseed meal	"	1.86	2.14	1.88
Sorgo silage (Sumac)	"	17.27	.....	.....
Cottonseed hulls	"	.....	10.04	.....
Sorgo fodder (Sumac)	"	.....	.....	10.68
Sudan grass hay	"	1.94	.....	.....
Feed required per 100 pounds gain:				
Ground milo heads	"	451.78	554.65	461.44
Cottonseed meal	"	82.72	115.86	84.47
Sorgo silage (Sumac)	"	765.77	.....	.....
Cottonseed hulls	"	.....	542.46	.....
Sorgo fodder (Sumac)	"	.....	.....	480.44
Sudan grass hay	"	85.96	.....	.....
Cost of feed per 100 pounds gain	dollars	11.46	13.60	11.57
Total feed consumed per head:				
Ground milo heads	pounds	1711.63	1723.63	1723.63
Cottonseed meal	"	313.38	360.03	315.51
Sorgo silage (Sumac)	"	2901.20	.....	.....
Cottonseed hulls	"	.....	1686.07	.....
Sorgo fodder (Sumac)	"	.....	.....	1794.60
Sudan grass hay	"	325.67	.....	.....
Financial Statement:				
Initial cost per steer	dollars	32.00	32.00	32.00
Cost of feed per steer	"	43.39	42.26	43.25
Shipping and marketing cost per head	"	3.75	3.75	3.75
Total cost of steer	"	79.14	78.01	79.00
Price received per steer	"	90.57	77.92	85.77
Necessary selling price to break even (per hundred pounds)	"	9.61	10.26	9.73
Selling price per hundred pounds, market weights	"	11.00	10.25	10.56
Profit or loss per steer	"	11.43 Profit	0.09 Loss	6.77 Profit

THE 1925-26 TEST

Rations and Gains by Periods for Third Test (1925-26)

The third year's test was a part of the cooperative meat project, "A Study of the Factors Affecting the Quality and Palatability of Meat." The steers were graded as feeders at the beginning of the test, as fat steers at the end, and their carcasses graded after slaughter. The meat phases of this project will be published in connection with the results of other meat studies.

Since the purpose of this test was that of comparing sorgo silage, cottonseed hulls, and sorgo fodder, it was planned to feed ground milo heads to each of the three lots on an equal basis. However, there was a slight difference in the average amount consumed by Lot 2 and that consumed by Lots 1 and 3 due to the fact that one steer in Lot 2 suffered a severe attack of digestive trouble in the early part of the third 28-day period and had to be removed from the experiment. This

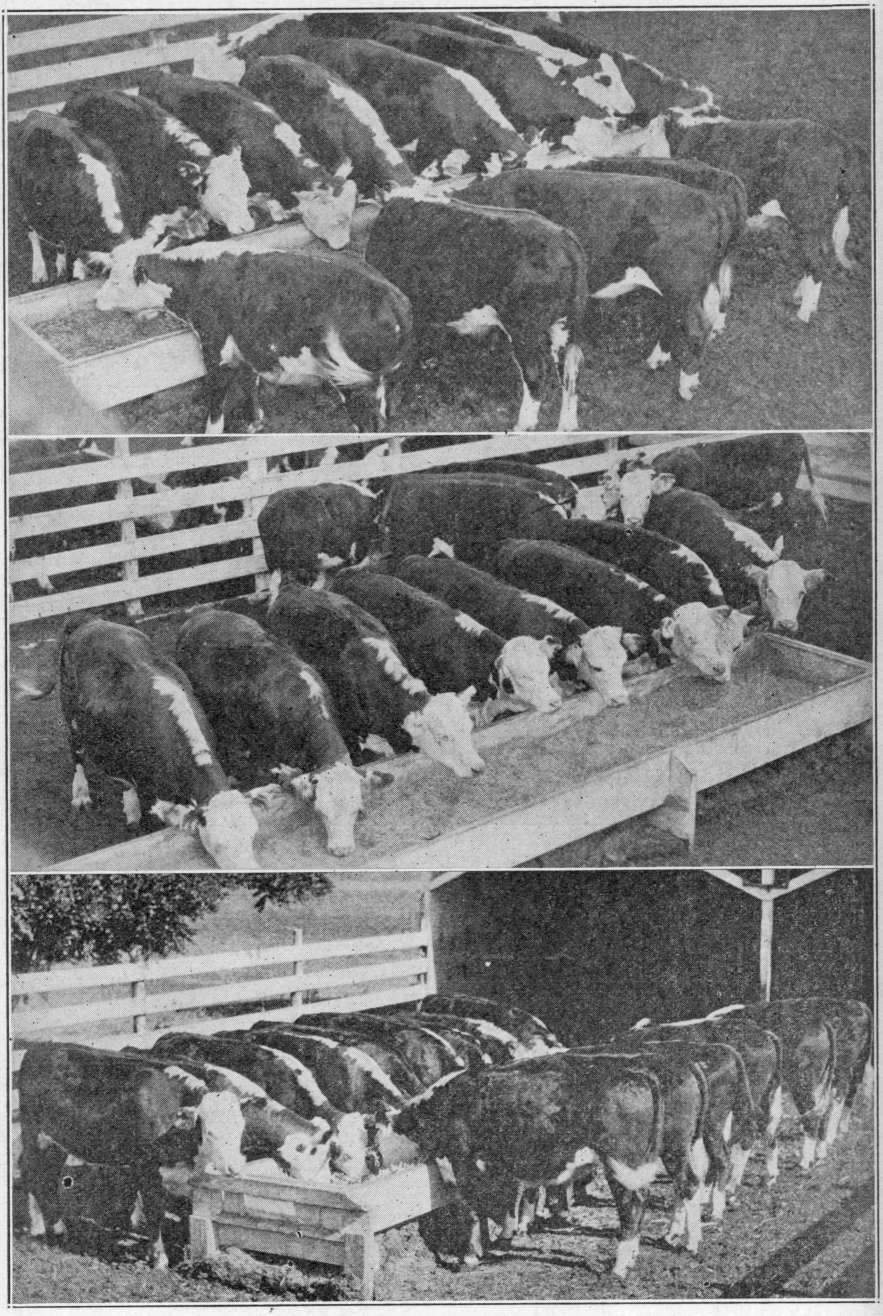

Figure 3.—Upper—Lot 1, fed sorgo silage, 1925–26.
Middle—Lot 2, fed cottonseed hulls, 1925–26.
Lower—Lot 3, fed sorgo fodder, 1925–26.

steer was figured out of the experiment from the beginning, which accounts for the slight discrepancy in the average amounts of ground milo heads consumed.

The average rations consumed per head and the average total and daily gains are given by periods for the respective lots in Table 10. The concentrates in the rations were increased gradually throughout the feeding period until during the last period when Lots 1 and 3 consumed an average of 13.9 pounds of ground milo heads and 2.4 pounds of cottonseed meal as compared with 12.33 pounds of ground milo heads and 2.33 pounds of cottonseed meal in Lot 2. The smaller average daily consumption of concentrates and roughage in Lot 2 during the final period was no doubt due in a measure to the long feeding period and to the high temperature prevailing during the latter part of the feeding period.

The maximum amount of concentrates utilized by the calves at any time was 14.66 pounds of ground milo heads by Lots 1 and 3, and 15 pounds of ground milo heads by Lot 2 during the early part of the last feeding period. Lots 1 and 3 consumed a maximum of 2.4 pounds of cottonseed meal during the last period as compared with a maximum of 2.57 pounds per head daily by Lot 2.

Quantity and Cost of Feed Required to Produce 100 Pounds of Gain

The amount and cost of the rations required to produce 100 pounds of gain are given by periods as well as for the entire 203-day period in Table 11. The average feed consumption per 100 pounds of gain, including costs, is given at the foot of Table 11 in the last three lines.

Although there are some apparent inconsistencies in the amounts of feed consumed per 100 pounds of gain by 28-day periods, Table 11 serves well to illustrate in a general way that the amount of feed required per 100 pounds of gain increases as the feeding period advances.

It is observed that the amount of concentrates required per 100 pounds of gain was much higher during the seventh period than in any of the preceding periods. In this particular test, one of the principal reasons for such small gains during the last period may be attributable to the increased temperature prevailing at that time. In this, as was true in the 1924-25 test, the gains in the cottonseed hull lot dropped off much more in the last period than those in the other two lots which received sorgo silage and sorgo fodder, respectively.

Marketing Data

The calves were sold on the Fort Worth market June 14, 1926, and did not show as much finish as did those fed in 1924-25. This is probably due to the younger age of the animals. Live stock commission salesmen and packer buyers pronounced Lots 1 and 3, which had been fed sorgo silage and sorgo fodder, respectively, as being the best

Table 10.—Average daily rations and gains by periods, 203 days, 1925-26. Fifteen steers in Lots 1 and 3, fourteen steers in Lot 2.

Lot No.	Ration	First 28-day Period, Pounds	Second 28-day Period, Pounds	Third 28-day Period, Pounds	Fourth 28-day Period, Pounds	Fifth 28-day Period, Pounds	Sixth 28-day Period, Pounds	Last Period of 35 days, Pounds	Average All Periods, Pounds
1	Ground milo heads	4.49	6.27	7.70	9.10	11.08	12.99	13.94	9.53
	Cotton seed meal	0.77	1.12	1.41	1.69	2.03	2.26	2.40	1.69
	Sorgo silage	14.12	11.79	14.25	14.05	13.13	12.75	11.51	13.03
	Sudan grass hay	0.62	0.82	0.86	0.81	0.88	0.95	0.92	0.84
	Total gain per calf	50.63	35.00	54.67	43.87	70.73	62.13	53.91	*370.96
	Average daily gain	1.81	1.25	1.95	1.57	2.53	2.22	1.54	1.83
2	Ground milo heads	4.55	6.35	7.80	9.26	11.27	13.23	12.33	9.51
	Cottonseed meal	0.82	1.27	1.56	1.86	2.21	2.42	2.33	1.83
	Cottonseed hulls	7.64	8.09	7.56	7.74	7.26	6.47	3.23	6.76
	Total gain per calf	56.62	42.71	39.71	43.00	57.92	58.57	26.14	*324.70
	Average daily gain	2.02	1.53	1.42	1.54	2.07	2.09	0.75	1.60
3	Ground milo heads	4.49	6.27	7.70	9.10	11.08	13.00	13.93	9.53
	Cottonseed meal	0.77	1.12	1.41	1.69	2.03	2.26	2.40	1.69
	Sorgo fodder	8.06	8.30	8.07	7.55	7.49	6.89	6.22	7.46
	Total gain per calf	50.74	47.20	47.60	53.80	56.40	66.73	48.75	*371.22
	Average daily gain	1.81	1.69	1.70	1.92	2.01	2.38	1.39	1.83

*Total gain for entire period.

Table 11.—Quantity of feed required to produce 100 pounds of gain, costs of feed, and average gain per head by periods of 28 days. Third test, 1925-26.*

Period	Lot No.	Feed Utilized Per 100 Pounds Gain						Cost of Feed Per 100 Lbs. Gain, Dollars	Average Gain Per Head During Period, Pounds
		Ground Milo Heads, Pounds	Cotton-seed Meal, Pounds	Sorgo Silage, Pounds	Cotton-seed Hulls, Pounds	Sorgo Fodder, Pounds	Sudan Grass Hay, Pounds		
1	1 silage	248	43	781	.....	.....	34	6.36	50.6
	2 hulls	225	40	.....	378	.....	.....	5.36	56.6
	3 fodder	248	43	.....	.....	445	.....	6.02	50.7
2	1 silage	502	90	943	.....	.....	66	10.97	35.0
	2 hulls	417	83	.....	530	.....	.....	9.24	42.7
	3 fodder	372	67	.....	.....	492	.....	8.21	47.2
3	1 silage	395	72	730	.....	.....	44	8.57	54.7
	2 hulls	550	110	.....	527	.....	.....	11.34	39.7
	3 fodder	453	83	.....	.....	475	.....	9.40	47.6
4	1 silage	581	108	896	.....	.....	52	12.04	43.9
	2 hulls	603	121	.....	504	.....	.....	12.06	43.0
	3 fodder	473	88	.....	.....	393	.....	9.34	53.8
5	1 silage	438	80	520	.....	.....	35	8.58	70.7
	2 hulls	545	107	.....	351	.....	.....	10.33	57.9
	3 fodder	550	101	.....	.....	372	.....	10.39	56.4
6	1 silage	585	102	575	.....	.....	42	10.97	62.1
	2 hulls	632	116	.....	309	.....	.....	11.36	58.6
	3 fodder	545	95	.....	.....	288	.....	9.83	66.7
7*	1 silage	905	156	747	.....	.....	60	16.48	53.9
	2 hulls	1769	334	.....	464	.....	.....	29.95	26.1
	3 fodder	1000	172	.....	.....	446	.....	17.57	48.8
All periods	1 silage	521	93	713	.....	.....	46	10.47	371.0
	2 hulls	595	114	.....	422	.....	.....	11.44	324.7
	3 fodder	521	93	.....	.....	408	.....	10.08	371.2

*Seventh period, 35 days.

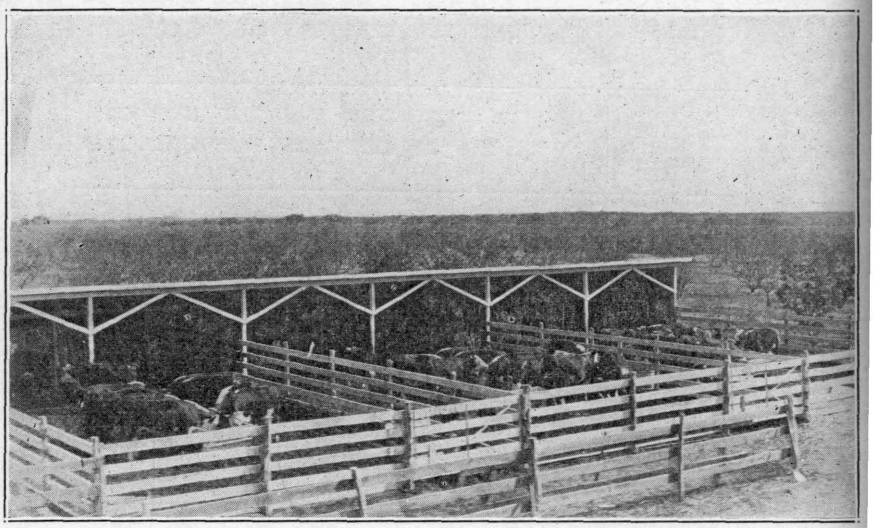

Figure 4.—View of cattle feeding pens at Big Spring.

and most uniformly finished, all agreeing that Lot 3 carried a slightly better finish than the silage-fed calves. Lot 2, fed cottonseed hulls, showed considerably less finish than Lots 1 and 3. Lot 3 sold at $9.75 per 100 pounds straight through; Lot 1 sold at $9.50 per hundred pounds straight through. In Lot 2, one calf sold at $10.00 per 100 pounds, this being, in the opinion of the cattle buyer, the highest finished steer in any lot; nine head sold at $9.25 per 100 pounds; two sold at $8.00; and two at $7.50 per 100 pounds. The calf in Lot 2 which sold at $10.00, a figure 25 cents higher than was paid for the calves in Lot 3, was a smooth individual but the dressed carcass grades did not bear out the previous judgment of the buyer, since the dressed carcass of this steer graded only medium. The estimated percentages of fat in the entire live animals at the close of the experiment (estimates based upon dressing percentages and upon weights of internal fat) were 22 per cent for Lot 1, 17 per cent for Lot 2, and 22 per cent for Lot 3.

Table 12 shows that the calves in Lots 1 and 3 gained on an average 46 pounds more per head during the 203-day feeding period than those in Lot 2. This additional 46 pounds was made at an additional cost of only $1.67. Although Lots 1 and 3 made similar gains, the feed cost per head was $1.38 higher for Lot 1 than for Lot 3. Lot 1 showed a loss of $12.06; Lot 2 a loss of $17.77; and Lot 3 a loss of $9.54 per head. These severe losses are accounted for by the fact that calves were purchased as feeders at a higher price per 100 pounds than the market paid for them after having been fed 203 days. Only small

Table 12.—Summary of third experiment in comparing sorgo (Sumac) silage, cottonseed hulls and sorgo (Sumac) fodder. November 13, 1925, to June 4, 1926, inclusive (203 days).

		Silage, Lot 1	Hulls, Lot 2	Fodder, Lot 3
Number of steers		15	14	15
Average initial weight at feed lot	pounds	310.89	310.23	306.80
Average final weight at feed lot	"	681.85	634.93	678.02
Average final weight at Fort Worth	"	640.00	599.30	635.33
Average gain per head, feed lot weights	"	370.96	324.70	371.22
Average gain per head, selling weights	"	329.11	289.07	328.53
Average daily gain per head, feed lot weights	"	1.83	1.60	1.83
Average daily gain per head, selling weights	"	1.62	1.42	1.62
Average daily ration:				
Ground milo heads	"	9.52	9.51	9.52
Cottonseed meal	"	1.69	1.83	1.69
Sorgo silage (Sumac)	"	13.03	.....	.....
Cottonseed hulls	"	.....	6.76	.....
Sorgo fodder (Sumac)	"	.....	.....	7.46
Sudan grass hay	"	0.84	.....	.....
Feed required per 100 pounds gain:				
Ground milo heads	"	521.24	594.83	520.86
Cottonseed meal	"	92.69	114.34	92.62
Sorgo silage (Sumac)	"	713.08	.....	.....
Cottonseed hulls	"	.....	422.63	.....
Sorgo fodder (Sumac)	"	.....	.....	408.16
Sudan grass hay	"	45.95	.....	.....
Cost of feed per 100 pounds gain	dollars	10.47	11.44	10.08
Total feed consumed per head:				
Ground milo heads	pounds	1933.57	1931.42	1933.57
Cottonseed meal	"	343.83	371.26	343.83
Sorgo silage (Sumac)	"	2645.20	.....	.....
Cottonseed hulls	"	.....	1372.29	.....
Sorgo fodder (Sumac)	"	.....	.....	1515.20
Sudan grass hay	"	170.47	.....	.....
Financial Statement:				
Initial cost per steer	dollars	30.00	30.00	30.00
Cost of feed per steer	"	38.80	37.13	37.42
Shipping and marketing cost per head	"	4.06	4.06	4.06
Total cost of steer	"	72.86	71.19	71.48
Price received per steer	"	60.80	53.42	61.94
Necessary selling price to break even (per hundred pounds)	"	11.38	11.88	11.25
Selling price per hundred pounds, market weights	"	9.50	8.91	9.75
Profit or loss per steer	"	12.06 Loss	17.77 Loss	9.54 Loss

gains were made during the last 35 days of the feeding period, which factor also exerted considerable influence in increasing the final loss sustained. As during the first and second tests, no labor charge was made against the steers; neither was any credit given for the manure produced, it being considered that the manurial value would offset the labor costs in feeding the cattle.

SUMMARY

Average Gains

The average gains made by the calves during 28-day* intervals throughout the three experiments are shown by the weight curves in Figure 5. In these experiments the cottonseed hulls fed to Lot 2 constituted 49 per cent of the ration in the 1923-24 test and 45 per cent in the 1924-25 test, as compared with only 37 per cent in the final test. This probably explains why the hulls ration supplied to Lot 2 gave results more nearly equal to the silage and fodder rations in the final test than it did in the first and second tests; namely, that the roughage constituted a smaller part of the ration in the third test.

Average Amounts of Feed Consumed

During the first two tests the average concentrates consumed per head daily averaged approximately 2.5 per cent of the initial weight of the calves, while in the third trial the concentrates averaged 3.6 per cent of the initial weight of the calves. The average daily gains per 1000 pounds of live weight were also calculated, and as shown in Table 13 the light weight calves fed in the third trial made considerably larger gains than did the heavier calves fed in each of the preceding tests. This is probably accounted for by the fact that the lighter calves consumed considerably more concentrates daily in proportion to their weight than did the calves fed in the first two tests. The roughage portion of the rations of the lighter calves fed in the third trial averaged considerably less than the daily roughage consumption in the two preceding trials.

In averaging the concentrate requirements per 100 pounds of gain by a simple arithmetic average in order to give equal emphasis to each of the three experiments, it was found that the silage fed calves required 20 per cent less ground milo heads and 25 per cent less meal per 100 pounds gain than did the calves fed cottonseed hulls, and 5.4 per cent less ground milo heads and 5.5 per cent less cottonseed meal than the calves fed fodder.

It required an average of 482 pounds of ground milo heads, 87 pounds of cottonseed meal, 827 pounds of sorgo silage, and 71 pounds of Sudan grass hay to produce 100 pounds of gain for the calves in Lot 1, as compared with 604 pounds of ground milo heads, 116 pounds of cottonseed meal, and 568 pounds of cottonseed hulls in Lot 2, and 509 pounds of ground milo heads, 92 pounds of cottonseed meal, and 483 pounds of sorgo fodder in Lot 3.

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*Except the final periods in the first and third tests, which covered a 35-day period.

Table 13.—Average feed consumed daily per calf; daily gains per calf; and per 1000 pounds liveweight.

Lot	Ration	Year	Milo Heads, Pounds	Cotton-seed Meal, Pounds	Sorgo Silage, Pounds	Cotton-seed Hulls, Pounds	Sorgo Fodder, Pounds	Sudan Grass Hay, Pounds	Average Initial Weight, Pounds	Average Daily Gain, Pounds	
										Per Head	Per 1000 Lbs. Live-weight
1	Silage	1923–24	9.0	1.6	19.2	.....	.....	1.6	429	1.91	3.20
		1924–25	10.2	1.9	17.3	.....	.....	1.9	507	2.26	3.24
		1925–26	9.5	1.7	13.0	.....	.....	0.8	311	1.83	3.69
	Average	.....	9.6	1.7	16.5	.....	.....	1.4	415	2.00	3.38
2	Hulls	1923–24	9.1	1.6	.....	10.2	.....	.....	433	1.37	2.48
		1924–25	10.3	2.1	.....	10.0	.....	.....	505	1.85	2.80
		1925–26	9.5	1.8	.....	6.8	.....	.....	310	1.60	3.39
	Average	.....	9.6	1.8	.....	9.0	.....	.....	416	1.61	2.89
3	Fodder	1923–24	9.1	1.6	.....	.....	9.3	.....	425	1.66	2.91
		1924–25	10.3	1.9	.....	.....	10.7	.....	507	2.22	3.25
		1925–26	9.5	1.7	.....	.....	7.5	.....	307	1.83	3.72
	Average	.....	9.6	1.7	.....	.....	9.2	.....	413	1.90	3.29

Table 14.—Feed required per 100 pounds gain.

Lot	Year	No. Days on Feed	Milo Heads, Pounds	Cotton-seed Meal, Pounds	Sorgo Silage, Pounds	Cotton-seed Hulls, Pounds	Sorgo Fodder, Pounds	Sudan Grass Hay, Pounds
1	1923–24	175	474	85	1003	.....	.....	81
	1924–25	168	452	83	766	.....	.....	86
	1925–26	203	521	93	713	.....	.....	46
	Average	.....	482	87	827	.....	.....	71
2	1923–24	175	661	119	.....	741	.....	.....
	1924–25	168	555	116	.....	542	.....	.....
	1925–26	203	595	114	.....	422	.....	.....
	Average	.....	604	116	.....	568	.....	.....
3	1923–24	175	546	98	.....	.....	560	.....
	1924–25	168	461	84	.....	.....	480	.....
	1925–26	203	521	93	.....	.....	408	.....
	Average	.....	509	92	.....	.....	483	.....

Salt Consumption

Granulated salt was kept before the calves at all times. Table 15 shows the daily consumption of salt per head.

Table 15.—Average daily consumption of salt per head.

Year	Number Days on Feed	Ounces		
		Lot 1 Silage	Lot 2 Cottonseed Hulls	Lot 3 Fodder
1923–24	175	.76	1.83	.76
1924–25	168	.67	1.13	.86
1925–26	203	1.13	1.33	.97
Average for three years	.....	.85	1.43	.86

Shrinkage and Slaughter

It is shown in Table 16 that shrinkage varied from 2.75 to 7.75 per cent of the weight of the animal. In the first year, shrinkage was lowest with Lot 3 fed fodder as a roughage, and highest with Lot 1 fed silage. In the second test Lot 3 had the heaviest shrinkage, and Lot 2, fed hulls, the lowest. In the third year Lot 2 was lowest again, but on an average of three years Lot 3, fed fodder, had the lowest shrinkage. The variation in shrinkage for each of the three years indicates, however, that three tests are not nearly enough to give significant results on shrinkage. The cattle were shipped a distance of 267 miles.

The dressing percentage as shown in Table 16 was a trifle higher in case of the lot fed silage for the first and third years. All lots killed out about the same—60 per cent—in the second test. The lot fed cotton seed hulls was considerably lower in the first and third years.

Table 16.—Shrinkage in transit and slaughter data.

Lot	Ration	Year	Shrinkage		Average Weight Dressed Carcasses, Pounds	Dressing Percentage		Average Weight Internal Fat, Pounds	Average Hide Weight, Pounds
			Per Head, Pounds	Per Cent		Basis Feed Lot Weights, Per Cent	Basis Market Weights, Per Cent		
1	Silage	1923–24	40.0	5.24	412.13	54.00	56.98	28.99	58.1
		1924–25	62.11	7.01	498.94	56.34	60.6	39.52	59.28
		1925–26	41.85	6.14	368.85	54.09	57.63	27.60	52.15
2	Hulls	1923–24	34.4	5.10	337.46	50.13	52.83	19.90	49.42
		1924–25	55.2	6.77	456.65	56.01	60.08	38.04	57.76
		1925–26	35.63	5.61	328.35	51.71	54.78	21.7	48.11
3	Fodder	1923–24	19.7	2.75	381.26	53.30	54.80	30.6	52.85
		1924–25	68.2	7.75	492.27	55.92	60.62	40.0	61.23
		1925–26	42.69	6.29	361.20	53.27	56.85	28.5	50.31

Lot 3 fed fodder had a noticeably greater amount of internal fat in every test, followed by Lot 1, fed silage. The internal fat in this instance is the ruffle and caul fat, and the amount of this is considered a partial index to the fatness of the carcass as a whole.

Table 17 shows the grading of the dressed carcasses as determined by a committee of three beef men from the packing industry. A study of this table shows clearly that the carcasses of Lot 2 fed cottonseed hulls did not possess the finish or degree of fatness found in those of Lots 1 and 3. The carcasses in Lot 1 graded somewhat higher than those in Lot 3 for the first two years, but Lot 3 showed considerable advantage in the last test.

Table 17.—Number of beef carcasses in various grades.

Year	Lot	Grades				
		Choice	Good to Choice	Good	Medium to Good	Medium
1923–24	1	4	6	4	.....	1
	2	.....	1	1	.....	13
	3	2	4	7	.....	2
1924–25	1	9	6	.....	.....	.....
	2	3	8	1	.....	3
	3	8	5	2	.....	.....
1925–26	1	4	.....	5	5	1
	2	.....	.....	2	7	5
	3	4	4	5	2	.....

Productive Energy Values

A comparison of the productive energy values secured in the feeding tests with calves at Big Spring, Texas, in the three tests are given in Table 18. Sorgo fodder was used as the standard. The "calculated" values in this table were calculated from the actual chemical composition of the feeds fed and the production coefficients given in Texas Station Bulletin No. 329, "Energy-Production Coefficients of American Feeding Stuffs."

Table 18.—Comparison of productive values of sorgo silage and cottonseed hulls expressed in therms of net energy per 100 pounds of feed. (Calculated from compositions of feeds used and actual gains made in the Big Spring feeding tests.)

	1923—1924		1924—1925		1925—1926	
	Calculated	Found From Test	Calculated	Found From Test	Calculated	Found From Test
Sorgo fodder used as a standard	29.5	.....	33.0	.....	31.0	.....
Sorgo silage	13.7	16.8	13.4	17.7	9.2	15.7
Cottonseed hulls	15.6	14.8	19.7	17.0	17.1	17.4

In calculating the value of a feed in actual experimental feeding work, it is necessary to take one feed as a standard to calculate the

productive energy of the other feeds to be compared, and to assume a definite maintenance requirement for the animal. In this calf-feeding experiment* sorgo fodder was used as the standard. The productive values of the concentrates used were calculated, using the coefficients given in Texas Bulletin 329, and the maintenance requirements given by Armsby in his "Principles of Animal Feeding."

Although the above assumptions may be claimed to lead to some uncertainty, yet since these figures are also used in connection with the other feeds compared with the standard, comparative results should be secured. This is especially the case if there is little difference between the quantity of additional feeds fed and no great difference in the average weights of the animals.

The method of calculation of the productive energy of the sorgo silage and cottonseed hulls used in the first experiment (1923-24) are given in Table 19. The maintenance requirements of 100 pounds of the average weight was assumed after Armsby as .75 therms. The therms required for one pound in gain of weight when ground milo heads and cottonseed meal were fed was 3.92 in the 1923-24 test. The values of the gains with the other feeds in terms of therms were calculated for 1923-24 using this figure (3.92 therms). The therms required for one pound gain in weight for 1924-25 was 3.78 and for 1925-26 was 3.90. In the tests reported in this Bulletin, the sorgo silage had a higher feeding value than did the cottonseed hulls, and evidently a somewhat higher value than is indicated by the productive value calculated from the information which has heretofore been available. The results of this work will be used to aid in securing the correct feeding value of sorgo silage as has already been done with ground kafir grain and kafir heads.† Cottonseed hulls have apparently the same feeding value as calculated but the value found is no doubt too high because the cost of gain in therms was really less than the value assumed. That is to say, the lot of calves receiving cottonseed hulls carried less finish at the end of the feeding period than the sorgo silage fed lot, which means that the gain in weight contained a smaller percentage of fat than for the silage fed calves, and this was produced at a lower cost in productive energy. The lower gain in weight of the lot receiving cottonseed hulls was due chiefly to the fact that the feeding value of the ration eaten by the calves was considerably less than that supplied the sorgo silage and sorgo fodder lots.

*Similar calculations covering experiments in lamb and steer feeding have been reported in Texas Station Bulletins Nos. 269, 285, 296, 305 and 309.

†Texas Station Bulletin No. 329.

Table 19.—Calculation of productive value of sorgo silage and cottonseed hulls used in first test, 1923-24.

	Lot 1 Sorgo Silage	Lot 2 Cotton-seed Hulls	Lot 3 Sorgo Fodder
Initial weight of animal	429	429	425
Final weight of animal	763	673	716
Average weight of animal, W	596	551	571
Average daily gain of animal, G	1.91	1.37	1.66
Average daily feed:			
Milo heads	9	9	9
Cottonseed meal	1.6	1.6	1.6
Sorgo silage, Z	19.5	.....	.....
Sudan hay	2.0	.....	.....
Sorgo hay	.....	.....	9.4
Cottonseed hulls, H_2	.....	10.0	.....
Productive value:			
Milo heads, 9 × .769 = R	6.92	6.92	6.92
Cottonseed meal, 1.6 × .699 = S	1.10	1.10	1.10
Sorgo hay, 9.4 × .295	.....	.....	2.77
Therms total, T	.....	.....	10.79
Maintenance required per animal, W × H* = M	4.47	4.13	4.28
Productive balance, T—M = B	.....	.....	6.51
Therms for 1 pound gain, B ÷ G = K	.....	.....	3.92
Value of gain, K × G = L	7.49	5.37	.....
Total energy value of ration, M + L = O	11.96	9.50	.....
Value of grain fed, R + S = P	8.02	8.02	.....
Sudan hay fed, 2 × .328 = U	.656	.....	.....
Value of cottonseed hulls, O—P = V	.....	1.48	.....
Value of silage, O—(P + U) = X	3.28	.....	.....
Productive energy of silage (X ÷ Z) × 100	16.8	.....	.....
Productive energy of cottonseed hulls (V ÷ H_2) × 100	.....	14.8	.....

*H = .0075, or the maintenance requirement in therms for each pound of live-weight. (Armsby.)

CONCLUSIONS AND RECOMMENDATIONS

Sorgo silage and sorgo fodder produced in each of the three tests larger gains than cottonseed hulls when fed to fattening calves. The average gain per head for the calves fed silage was 361.4 pounds; for the calves fed cottonseed hulls 291.8 pounds; and 345.1 pounds for those fed chopped sorgo fodder.

The calves fed silage on the basis of three years' average gained 23.9 per cent more than the calves fed on cottonseed hulls and 4.7 per cent more than the calves fed on sorgo fodder.

The average daily gain made by the calves fed silage was 2 pounds per head or 3.38 pounds per 1000 pounds live weight; for the calves fed cottonseed hulls, 1.61 pounds per head or 2.89 pounds per 1000 pounds live weight; and for the calves fed fodder, 1.9 pounds per head or 3.29 pounds per 1000 pounds live weight.

The calves fed on silage and fodder, respectively, made larger and more uniform gains throughout the feeding period than those fed on cottonseed hulls.

The calves fed cottonseed hulls through feeding periods ranging between 168 and 203 days made reduced gains during the latter part of the feeding period, which factor tended greatly to increase the feed requirement per 100 pounds of gain.

The calves fed cottonseed hulls did not possess the finish that was found in the calves fed silage and the calves fed fodder. There was little difference in finish between the calves fed silage and those fed fodder. The lot fed silage seemed before slaughter to possess a slight advantage in this respect in the first two tests while the calves fed fodder showed a slightly higher finish in the third experiment. However, the carcasses from Lots 1 and 3 on a three-year average were about the same in quality. Those from Lot 1 fed silage had a slight advantage the first year, and Lot 3 a considerable advantage the last year. Judging from the internal fat, Lot 3, fed fodder, showed more finish in each test.

This experiment shows conclusively that sorgo silage and fodder are more satisfactory roughages than cottonseed hulls when fed along with ground milo heads and cottonseed meal to fattening calves.

In total cost of feed per head there was little variation between lots, the cottonseed hull ration being slightly cheapest the last two years. There was no relation, however, between the total cost of feed per steer and the cost of 100 pounds gain and the net returns, as Lot 1, fed silage, had the highest total feed cost, yet the lowest cost per 100 pounds gain and accordingly made greater returns. On the basis of a three-year average, Lot 1, fed silage, had a cost of $11.33 per 100 pounds gain; Lot 2, fed cottonseed hulls, $13.80; and Lot 3, fed fodder, $11.38.

The economy and rate of gain and sales price are the factors directly affecting the net returns. Cattle making the greatest gains, other things being equal, have the highest finish, and bring higher prices. Higher sales prices on such cattle usually offset any increased cost of gain.

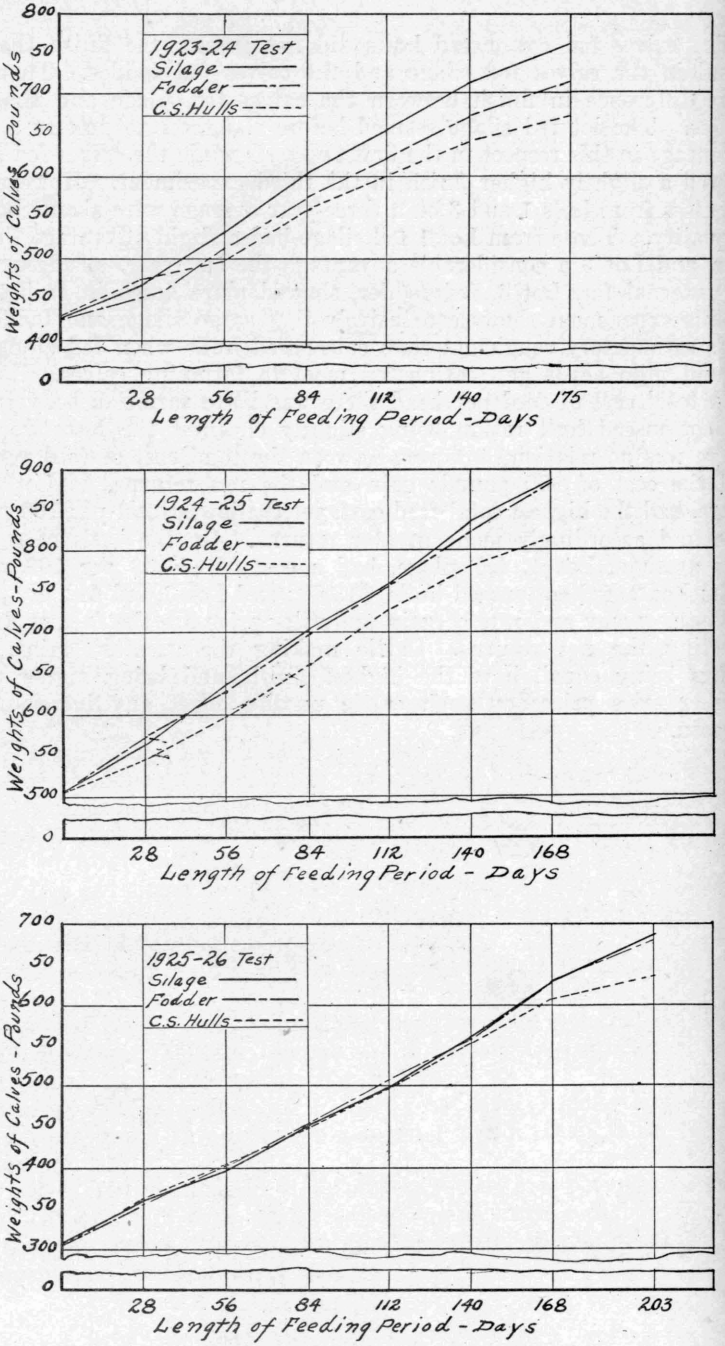

Figure 5.—Upper—Showing gains made by calves, 1923–24.
Middle—Showing gains made by calves, 1924–25.
Lower—Showing gains made by calves, 1925–26.